

Instructional Framework

Automotive Technologies

47.0600.20

This Instructional Framework identifies, explains, and expands the content of the standards/measurement criteria, and, as well, guides the development of multiple-choice items for the Technical Skills Assessment. This document corresponds with the Technical Standards endorsed on May 25, 2022.



Domain 1: Chassis Systems

Instructional Time: 30 – 35%

STANDARD 4.0 PERFORM SUSPENSION AND STEERING SYSTEM SERVICES—GENERAL

4.1 Research vehicle service information including fluid type, service precautions and procedures, technical service bulletins, and recalls

- Locate and describe where to find vehicle identification markers, stickers, and placards
 - VIN #
 - Make, Model, Year, Engine Size, Trim Level
 - Mileage
 - Service History
- Conduct online service information research on various vehicles
 - Fluid specs and capacities
 - Maintenance schedule
 - Service precautions
 - Service procedures
 - Technical Service Bulletins (TSB's)
 - Vehicle recalls and/or campaigns

4.2 Identify vehicle systems, including advanced driver assistance systems (ADAS)

- Explain advanced steering assist systems
- Lane Keep Assist
- Steer by wire systems
- Identify and describe the operation of Advanced Driver Assistance Systems (ADAS)
 - Lane Departure Warning/Correction
 - Automatic Emergency Braking (AEB)
 - Blind Spot Detection
 - Adaptive Cruise Control
 - Adaptive Lighting Control
 - Automatic Parking

	<ul style="list-style-type: none"> ○ Driver Monitoring Systems
4.3 Describe suspension and steering system components and configurations	<ul style="list-style-type: none"> ● Identify and describe different suspension and steering system configurations <ul style="list-style-type: none"> ○ Rack and pinion, electronic rack and pinion, parallelogram steering, etc. ○ Independent vs. Non-Independent suspension systems ○ Short/Long Arm suspension, MacPherson Strut Suspension, Leaf Spring, Solid Axle, Coil Spring, Torsion Bar ● Identify and describe the components and operation of steering and suspension systems <ul style="list-style-type: none"> ○ Rack and pinion, electronic rack and pinion, parallelogram steering, etc. ○ Independent vs. Non-Independent suspension systems ○ Short/Long Arm suspension, MacPherson Strut Suspension, Leaf Spring, Solid Axle, Coil Spring, Torsion Bar
4.4 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed	<ul style="list-style-type: none"> ● Perform a full vehicle module system scan utilizing a scan tool ● Navigating scan tool software, identify and record <ul style="list-style-type: none"> ○ Diagnostic Trouble Codes (DTCs) ○ On-Board Diagnostic (OBD) Monitor Status ○ Freeze Frame Data ● Demonstrate the proper procedure for clearing DTCs and describe what that does to OBD monitors
4.5 Disable and enable supplemental restraint system (SRS); verify indicator lamp operation	<ul style="list-style-type: none"> ● Research various vehicle manufacturer procedure on enabling and disabling of the SRS system ● Practice enabling and disabling SRS on various vehicles following manufacturer procedures ● Verify SRS indicator lamp operation on various vehicles
4.6 Inspect rack and pinion steering gear inner tie rod ends (sockets) bellows boots	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting rack and pinion steering gear inner tie rod ends (sockets) bellows boots ● Perform a visual inspection of rack and pinion steering gear inner tie rod ends (sockets) bellows boots
4.7 Inspect power steering fluid level and condition	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting power steering fluid level and condition on various vehicles with dipsticks and/or reservoirs

	<ul style="list-style-type: none"> ● Perform a visual inspection of power steering fluid level and condition
4.8 Flush, fill, and bleed power steering system using proper fluid type per manufacturer specification	<ul style="list-style-type: none"> ● Flush, fill, and bleed power steering systems on various vehicles following manufacturer service procedures ● Research proper power steering fluid type and quantity per manufacturer specifications <ul style="list-style-type: none"> ○ Electrohydraulic steering system fluid
4.9 Inspect for power steering fluid leakage	<ul style="list-style-type: none"> ● Identify the potential leakage points on various vehicle power steering systems ● Inspect power steering system for fluid leakage at the potential leakage points
4.10 Remove, inspect, replace, and/or adjust power steering pump drive belt	<ul style="list-style-type: none"> ● Identify various power steering pump drive belt configurations on different vehicles ● Proper removal and installation procedure following manufacturer service procedures
4.11 Inspect and replace power steering hoses and fittings	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting power steering hoses and fittings ● Perform a visual inspection of power steering hoses and fittings ● Research information regarding proper removal and installation procedure following manufacturer service procedures ● Remove and replace power steering hoses and fittings following manufacturer service procedures
4.12 Inspect pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Pitman arm ○ Center link ○ Idler arm ○ Steering linkage damper ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Pitman arm ○ Center link ○ Idler arm ○ Steering linkage damper

	<ul style="list-style-type: none"> ● Research information
4.13 Inspect tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion)	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting a non-rack and pinion steering ● Perform a visual inspection (check for wear) of a non-rack and pinion steering including <ul style="list-style-type: none"> ○ Tie rods ○ Tie rod sleeves ○ Clamps ○ Visual inspection ● Check for wear ● Research information
4.14 Describe an electric power steering system	<ul style="list-style-type: none"> ● Describe the operation on various electric power steering systems <ul style="list-style-type: none"> ○ Column and rack mounted steering assist ○ Electrohydraulic assist system
4.15 Inspect upper and lower control arms, bushings, and shafts	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Upper and lower control arms ○ Bushings ○ Shafts ● Perform a visual inspection and check for wear of <ul style="list-style-type: none"> ○ Upper and lower control arms ○ Bushings ○ Shafts ● Research information
4.16 Inspect and replace rebound/jounce bumpers	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting rebound/jounce bumpers ● Perform a visual inspection of rebound/jounce bumpers ● Research information ● Replacement of bump stops
4.17 Inspect track bar, strut rods/radius arms, and related mounts and bushings	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Track bar ○ Strut rods ○ Bushings

	<ul style="list-style-type: none"> ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Track bar ○ Strut rods ○ Bushings ● Research information
4.18 Inspect upper and lower ball joints (with or without wear indicators)	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting upper and lower ball joints ● Perform a visual inspection of upper and lower ball joints ● Research information including <ul style="list-style-type: none"> ○ Proper testing methods ○ Manufacturer recommendations/procedures
4.19 Inspect suspension system coil springs and spring insulators	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Coil spring ○ Spring insulator ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Coil spring ○ Spring insulator ● Research information
4.20 Inspect torsion bars and mounts	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Torsion bars ○ Torsion bar mount ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Torsion bars ○ Torsion bar mount ● Research information
4.21 Inspect and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Stabilizer bar ○ Bushings ○ Brackets ● Perform a visual inspection and check for wear of <ul style="list-style-type: none"> ○ Stabilizer bar ○ Bushings ○ Brackets

	<ul style="list-style-type: none"> ● Research information
4.22 Inspect, remove and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting strut assembly, strut coil spring, insulators, and upper strut bearing mount ● Perform a visual inspection of strut assembly, strut coil spring, insulators, and upper strut bearing mount ● Research information <ul style="list-style-type: none"> ○ Proper procedure for disassembly and assembly ○ Safety around compressed springs ○ Manufacturer procedures for removal
4.23 Inspect suspension system leaf spring(s), spring insulators (silencers), shackles, brackets, bushings, center pins/bolts, and mounts	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Leaf springs ○ Spring insulator ○ Shackles ● Perform a visual inspection and check for wear of <ul style="list-style-type: none"> ○ Leaf springs ○ Spring insulator ○ Shackles ● Research information
4.24 Inspect components of electronically controlled suspension systems	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Adjustable shocks and struts ○ Adjustable ride height suspensions ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Adjustable shocks and struts ○ Adjustable ride height suspensions ● Research information
4.25 Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting shock absorbers, mounts, and bushings ● Perform a visual inspection of shock absorbers, mounts and bushings ● Research information <ul style="list-style-type: none"> ○ Proper procedure for removal and installation

4.26 Inspect front and rear wheel bearings	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Press wheel bearings ○ Unit Hub wheel bearings ○ Serviceable wheel bearings ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Press wheel bearings ○ Unit Hub wheel bearings ○ Serviceable wheel bearings ● Research information
4.27 Describe the function of electronically controlled suspension and steering systems and components (e.g., active suspension and stability control)	<ul style="list-style-type: none"> ● Active suspension ● Stability control
4.28 Perform pre-alignment inspection; measure vehicle ride height	<ul style="list-style-type: none"> ● Checking for bent components ● Ride height
4.29 Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling/tire wear	<ul style="list-style-type: none"> ● Describe caster, camber, and toe ● Describe how caster, camber, and toe effects vehicle handling/tire wear
4.30 Inspect tire condition/age; identify tire wear patterns; check for correct tire size, application (service-class, load and speed ratings), and air pressure as listed on the tire information placard/label	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Tire wear patterns ○ Tire size ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Tire wear patterns ○ Tire size ● Research information
4.31 Rotate tires according to manufacturer's recommendation including vehicles equipped with tire pressure monitoring systems (TPMS)	<ul style="list-style-type: none"> ● Manufacturer's recommendation ● Relearning TPMS ● Staggered tire sizes
4.32 Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly	<ul style="list-style-type: none"> ● Mount and dismount tire on tire machine ● Care of TPMS sensor ● Wheel balancing static/dynamic
4.33 Inspect tire and wheel assembly for air loss; determine necessary	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting tire and wheel assembly for air loss

action	<ul style="list-style-type: none"> ● Perform a visual inspection of tire and wheel assembly for air loss ● Research information <ul style="list-style-type: none"> ○ Inspection for punctures ○ Dunk tank method
4.34 Repair tire following tire manufacturer approved procedure	<ul style="list-style-type: none"> ● Proper procedure for tire repair
4.35 Describe indirect and direct tire pressure monitoring systems (TPMS); calibrate/relearn system; verify operation of instrument panel lamps	<ul style="list-style-type: none"> ● Indirect tire pressure monitoring system ● Calibration
4.36 Explain the steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS)	<ul style="list-style-type: none"> ● Remove and replace TPMS sensors ● Program new sensor ID numbers
4.37 Perform Road Force balance/match mounting	<ul style="list-style-type: none"> ● Road Force balancing of tires ● Force matching tire and wheel
STANDARD 5.0 PERFORM BRAKE SYSTEM SERVICES—GENERAL	
5.1 Research vehicle service information including fluid type, service precautions and procedures, technical service bulletins, and recalls	<ul style="list-style-type: none"> ● Locate and describe where to find vehicle identification markers, stickers, and placards <ul style="list-style-type: none"> ○ VIN # ○ Make, Model, Year, Engine Size, Trim Level ○ Mileage ○ Service History ● Conduct online service information research on various vehicles <ul style="list-style-type: none"> ○ Fluid specs and capacities ○ Maintenance schedule ○ Service precautions ○ Service procedures ○ Technical Service Bulletins (TSB's) ○ Vehicle recalls and/or campaigns
5.2 Identify vehicle systems, including advanced driver assistance systems (ADAS)	<ul style="list-style-type: none"> ● Explain Forward Emergency Braking ● Explain Adaptive Cruise Control ● Identify and describe the operation of Advanced Driver Assistance Systems (ADAS) <ul style="list-style-type: none"> ○ Lane Departure Warning/Correction

	<ul style="list-style-type: none"> ○ Automatic Emergency Braking ○ Blind Spot Detection ○ Adaptive Cruise Control ○ Adaptive Lighting Control ○ Automatic Parking ○ Driver Monitoring Systems
5.3 Identify brake system components and configuration	<ul style="list-style-type: none"> ● Identify various vehicle brake system configurations <ul style="list-style-type: none"> ○ 4-wheel drum brakes ○ Front disc, rear drum ○ 4-wheel disc brakes ○ ABS ● Identify various vehicle brake system components ● Master cylinder, brake booster, lines, calipers, rotors, drum brake assemblies, pads/shoes, valves, switches, ABS components, etc.
5.4 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed	<ul style="list-style-type: none"> ● Identify DTC's and their meaning ● Retrieve and clear OBD codes ● Identify live data and freeze frame data ● Perform a full vehicle module system scan utilizing a scan tool ● Navigating scan tool software, identify and record <ul style="list-style-type: none"> ○ Diagnostic Trouble Codes (DTCs) ○ On-Board Diagnostic (OBD) Monitor Status ○ Freeze Frame Data ● Demonstrate the proper procedure for clearing DTCs and describe what that does to OBD monitors
5.5 Describe procedure for performing a road test to check brake system operation including an anti-lock brake system (ABS)	<ul style="list-style-type: none"> ● Road test parameters ● Check brake operation ● Check ABS brake operation ● Describe operation for performing road test ● List items you should be feeling/looking for while performing a road test to check brake system operation, including ABS
5.6 Install wheel and torque lug nuts	<ul style="list-style-type: none"> ● Lug nut torque sequence ● Lug nut torque specifications ● Lug stud installation ● Research proper spec for vehicle lug nut torque

	<ul style="list-style-type: none"> Remove and install wheel, make sure lug nuts are installed correctly, and torque lug nuts to factory specifications
5.7 Explain hydraulic principals (Pascal's law)	<ul style="list-style-type: none"> Explain Pascal's law
5.8 Describe proper brake pedal height, travel, and feel	<ul style="list-style-type: none"> Brake pedal height Brake pedal travel Brake pedal feel
5.9 Check master cylinder for external leaks and proper operation	<ul style="list-style-type: none"> Identify master cylinder seals Check for proper operation of master cylinder Identify various leakage points on a brake master cylinder Inspect brake master cylinder for external leaks Check for proper brake master cylinder operation
5.10 Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports	<ul style="list-style-type: none"> Identify where to look and what to look for when visually inspecting brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports Perform a visual inspection of brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports Research information <ul style="list-style-type: none"> Identify rigid and flexible brake lines
5.11 Explain procedures for selecting, handling, storing, and filling brake fluids to proper level; use proper fluid type per manufacturer specification	<ul style="list-style-type: none"> Brake fluid handling Proper brake fluid filling procedure Identify correct brake fluid for vehicle type
5.12 Describe components of hydraulic brake warning light system	<ul style="list-style-type: none"> Brake warning light symbol Brake warning light components Float Identify and describe the components that make up the hydraulic brake warning light system (brake fluid level switch, RED brake light, pressure sensors)
5.13 Explain procedures for bleeding and/or replacing fluid in the brake system	<ul style="list-style-type: none"> Bleeding procedure/manufacturer specific Power/Vacuum/Two-Person Method
5.14 Test brake fluid for contamination	<ul style="list-style-type: none"> Brake fluid testing Test strips Identify how brake fluid gets contaminated

	<ul style="list-style-type: none"> • Test brake fluid for contamination using various methods (electronic tester, strips, etc.)
5.15 Explain the removal, cleaning, and inspecting of a brake drum including measuring the brake drum diameter	<ul style="list-style-type: none"> • Safety • Part identification • Research information <ul style="list-style-type: none"> ○ Use of precision measuring tools ○ Minimum/maximum ○ Discard thickness • Procedure
5.16 Explain the procedures for refinishing brake drums including final drum measurement and diameter; compare with specification	<ul style="list-style-type: none"> • Brake drum removal • Brake drum inspection • Brake drum measuring
5.17 Explain the removal, cleaning, inspecting, and/or replacement of brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubrication and reassembling	<ul style="list-style-type: none"> • Manufacturer recommended procedure • Drum brake hardware identification • Drum Brake Hardware Assembly Procedure
5.18 Explain procedures for inspecting wheel cylinders for leaks and proper operation; remove and replace as needed	<ul style="list-style-type: none"> • Wheel cylinder identification • Wheel cylinder operation
5.19 Explain procedures for preadjusting brake shoes and parking brake; installing brake drums or drum/hub assemblies and wheel bearings; making final checks and adjustments	<ul style="list-style-type: none"> • Drum Brake Adjustment Procedure • Drum Brake Assembly Procedure • Drum Post Inspection
5.20 Remove and clean caliper assembly; inspect for leaks and damage/wear	<ul style="list-style-type: none"> • Brake Caliper Removal Procedure • Brake Caliper Inspection
5.21 Inspect caliper mounting and slides/pins for proper operation, wear, and damage	<ul style="list-style-type: none"> • Identify where to look and what to look for when visually inspecting caliper mounting and slides/pins for proper operation, wear, and damage • Perform a visual inspection of caliper mounting and slides/pins for proper operation, wear, and damage • Research information <ul style="list-style-type: none"> ○ Brake caliper mounting bracket ○ Brake Caliper Slide Lubrication Procedure
5.22 Remove, inspect, and/or replace brake pads and retaining hardware	<ul style="list-style-type: none"> • Brake Pad Removal Procedure • Brake Pad and Hardware Inspection

5.23 Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor and inspect for leaks	<ul style="list-style-type: none"> • Brake Pad Installation Procedure • Brake Caliper Installation Procedure
5.24 Clean and inspect rotor and mounting surface, measure rotor thickness, thickness variation, and lateral runout; determine necessary action	<ul style="list-style-type: none"> • Brake Rotor Inspection • Brake Rotor Measurements • Brake Rotor Specifications
5.25 Remove and reinstall/replace rotor	<ul style="list-style-type: none"> • Brake Rotor Removal • Brake Rotor Installation
5.26 Refinish rotor on vehicle; measure final rotor thickness and compare with specification	<ul style="list-style-type: none"> • Explain advantages of on-car lathe • Identify minimum and discard thickness • Procedure <ul style="list-style-type: none"> ○ Cleaning hub
5.27 Explain procedures to refinish rotor off vehicle; measuring final rotor thickness and comparing with specification	<ul style="list-style-type: none"> • Brake rotor off vehicle resurfacing • Research information <ul style="list-style-type: none"> ○ Precision measuring ○ Manufacturer specifications ○ Minimum and discard thickness • Procedure <ul style="list-style-type: none"> ○ Cleaning hub
5.28 Retract and re-adjust caliper piston on an integral parking brake system	<ul style="list-style-type: none"> • Piston compression procedure according to manufacturer • Use of special tools for retracting piston
5.29 Measure brake pad wear; determine necessary action	<ul style="list-style-type: none"> • Electronic brake pad wear indicators • Mechanical brake pad wear indicators
5.30 Explain the procedure to burnish/break-in replacement brake pads according to manufacturer's recommendation	<ul style="list-style-type: none"> • Brake Burnishing Procedure • Follow manufacturer recommendations
5.31 Check brake pedal travel with, and without, engine running to verify proper power booster operation	<ul style="list-style-type: none"> • Brake booster operation • Engine off brake pedal height check
5.32 Describe the components of the brake power assist system (vacuum/hydraulic/electric)	<ul style="list-style-type: none"> • Identify power brake system between vacuum and hydraulic assist • Identify power brake system between vacuum and hydraulic assist components
5.33 Remove, clean, inspect, repack/replace, and install wheel bearings;	<ul style="list-style-type: none"> • Wheel bearing inspection

remove and install bearing races; replace seals; install hub and adjust bearings	<ul style="list-style-type: none"> • Wheel bearing repack • Wheel bearing hub replacement • Adjusting preload
5.34 Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as necessary	<ul style="list-style-type: none"> • Inspect parking brake components • Inspect parking brake cable for kinks or binding • Lubricate portions of parking brake assembly if recommended by manufacturer
5.35 Check parking brake operation (including electric parking brakes); and parking brake indicator light system operation	<ul style="list-style-type: none"> • Operation of parking brake indicator light system • Repair procedures of parking brake indicator light system
5.36 Check operation of brake stop light system	<ul style="list-style-type: none"> • Inspection of LED and Incandescent brake lights • Define CHMSL
5.37 Describe the electronic brake control system components and function (ABS, TCS, ESC)	<ul style="list-style-type: none"> • Describe ABS system and components • Describe TCS system and components
5.38 Describe the operation of a regenerative braking system	<ul style="list-style-type: none"> • Safety • Part identification • Operation of regen braking system • Describe the theory and operation of regenerative braking system and how that increases vehicle efficiency
5.39 Inspect wheel studs and describe procedures for replacement	<ul style="list-style-type: none"> • Identify where to look and what to look for when visually inspecting wheel studs • Perform a visual inspection of wheel studs • Research information <ul style="list-style-type: none"> ○ Repair procedures for wheel studs and assembly ○ Specifications ○ Identify what to look for when inspecting wheel studs ○ Inspect wheel studs ○ Describe the procedure for replacing wheel studs if found damaged

Domain 2: Electrical Systems and Safety

Instructional Time: 30 – 35%

STANDARD 6.0 PERFORM ELECTRICAL/ELECTRONIC SYSTEM SERVICES—GENERAL

6.1 Research vehicle service information including fluid type, service precautions and procedures, technical service bulletins, and recalls

- Locate and describe where to find vehicle identification markers, stickers, and placards
 - VIN #
 - Make, Model, Year, Engine Size, Trim Level
 - Mileage
 - Service History
- Conduct online service information research on various vehicles
 - Fluid specs and capacities
 - Maintenance schedule
 - Service precautions
 - Service procedures
 - Technical Service Bulletins (TSB's)
 - Vehicle recalls and/or campaigns

6.2 Identify vehicle systems and electrical/electronic system components and configurations, including advanced driver assistance systems (ADAS)

- Identify electrical system components
- Identify vehicle electrical systems
- Identify ADAS systems
- Identify and describe the operation of Advanced Driver Assistance Systems (ADAS)
 - Lane Departure Warning/Correction
 - Automatic Emergency Braking
 - Blind Spot Detection
 - Adaptive Cruise Control
 - Adaptive Lighting Control
 - Automatic Parking
 - Driver Monitoring Systems

6.3 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed

- Identify DTC's and their meaning
- Retrieve and clear OBD codes
- Identify live data and freeze frame data
- Perform a full vehicle module system scan utilizing a scan tool
- Navigating scan tool software, identify and record

	<ul style="list-style-type: none"> ○ Diagnostic Trouble Codes (DTCs) ○ On-Board Diagnostic (OBD) Monitor Status ○ Freeze Frame Data ● Demonstrate the proper procedure for clearing DTCs and describe what that does to OBD monitors
6.4 Describe electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law)	<ul style="list-style-type: none"> ● Series circuits ● Parallel circuits ● Electrical principles
6.5 Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance	<ul style="list-style-type: none"> ● Digital multimeter ● Voltage drop test ● Current flow ● Resistance
6.6 Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits	<ul style="list-style-type: none"> ● Shorts to voltage and ground ● Resistance in ground side ● Open circuits ● Resistance in power side
6.7 Use fused jumper wires to check operation of electrical circuits per service information	<ul style="list-style-type: none"> ● Electronic control module protection ● Jumper wire procedures
6.8 Use wiring diagrams to trace electrical/electronic circuits	<ul style="list-style-type: none"> ● Safety <ul style="list-style-type: none"> ○ High voltage ● Part identification ● Research information <ul style="list-style-type: none"> ○ Color codes ○ Wire diagrams ○ Identifying components ○ Electrical symbols ● Procedure
6.9 Measure key-off battery drain (parasitic draw)	<ul style="list-style-type: none"> ● Parasitic draw ● Research Technical Service Bulletins (TSB) ● Manufacturer specific test ● Procedure
6.10 Inspect and test fusible links, circuit breakers, and fuses; determine necessary action	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Fusible links

	<ul style="list-style-type: none"> ○ Circuit breakers ○ Fuse operations ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Fusible links ○ Circuit breakers ○ Fuse operations ● Research information
6.11 Repair and/or replace connectors, terminal ends, and wiring of electrical/electronic systems	<ul style="list-style-type: none"> ● Replacement of connectors ● Servicing SRS wiring and connectors ● Replacing terminals inside connectors
6.12 Perform battery state-of-charge test; determine necessary action	<ul style="list-style-type: none"> ● Capacitance testers ● State of charge test procedures
6.13 Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test	<ul style="list-style-type: none"> ● Safety ● Battery capacity ● Load test procedure
6.14 Maintain or restore electronic memory functions as recommended by manufacturer	<ul style="list-style-type: none"> ● Manufacturer specifications ● Memory Savers
6.15 Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold-downs	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting battery, cables, connectors, clamps, and hold-downs ● Perform a visual inspection of battery, cables, connectors, clamps, and hold-downs ● Research information <ul style="list-style-type: none"> ○ Proper connection procedure ○ First aid procedures ● Clean battery ● Fill battery
6.16 Perform battery charging according to manufacturer's recommendations	<ul style="list-style-type: none"> ● Battery charging procedures ● Positive post ● Negative post ● Identify charge rate
6.17 Explain procedures for jump-starting a vehicle using jumper cables and a booster battery or an auxiliary power supply	<ul style="list-style-type: none"> ● Manufacturer procedure ● Hybrid vehicle jump starting ● Proper jump-start procedure

6.18 Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery	<ul style="list-style-type: none"> ● Radio/Infotainment systems ● Radio codes ● Security systems/resetting ● Navigation systems
6.19 Perform starter current draw test; determine necessary action	<ul style="list-style-type: none"> ● Performing current draw test
6.20 Perform starter circuit voltage drop tests; determine necessary action	<ul style="list-style-type: none"> ● Voltage drop procedures
6.21 Inspect and test starter relays and solenoids; determine necessary action	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting starter relays and solenoids ● Perform a visual inspection of starter relays and solenoids ● Research information <ul style="list-style-type: none"> ○ Proper testing procedures
6.22 Describe the removal and installation of a starter in a vehicle	<ul style="list-style-type: none"> ● Safety <ul style="list-style-type: none"> ○ Disconnect battery ● Part identification ● Research information ● Procedure
6.23 Explain the operation of an automatic idle-stop/start-stop system	<ul style="list-style-type: none"> ● Explain components ● Uses and disable functions
6.24 Perform charging system output test; determine necessary action	<ul style="list-style-type: none"> ● Charging system output test
6.25 Explain removal/replacement procedures for generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment	<ul style="list-style-type: none"> ● Safety ● Part identification ● Research information ● Procedure
6.26 Remove, inspect, and/or reinstall generator (alternator)	<ul style="list-style-type: none"> ● Generator ● Drive belts ● Pulley ● Visual inspection
6.27 Perform charging circuit voltage drop tests; determine necessary action	<ul style="list-style-type: none"> ● Research information <ul style="list-style-type: none"> ○ Purpose of circuit voltage drop test ● Procedure for charging system voltage drop test

<p>6.28 Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting <ul style="list-style-type: none"> ○ Exterior lamp inspections ○ Socket inspection ○ LED lights ○ High voltage lights ● Perform a visual inspection of <ul style="list-style-type: none"> ○ Exterior lamp inspections ○ Socket inspection ○ LED lights ○ High voltage lights ● Research information
<p>6.29 Aim headlights</p>	<ul style="list-style-type: none"> ● Research information <ul style="list-style-type: none"> ○ Manufacturer specifications ● Procedure for aiming headlights
<p>6.30 Describe vehicle comfort, convenience, access, safety, and related systems operation</p>	<ul style="list-style-type: none"> ● Describe comfort, and convenience systems ● Operation of ancillary safety systems
<p>6.31 Describe the operation of keyless entry/remote-start systems</p>	<ul style="list-style-type: none"> ● Part identification <ul style="list-style-type: none"> ○ Battery ○ FOB ● Research information <ul style="list-style-type: none"> ○ Manufacturer Specifications
<p>6.32 Describe procedures for disabling and enabling for supplemental restraint system (SRS); verify indicator lamp operation</p>	<ul style="list-style-type: none"> ● Wiring diagrams for SRS ● Proper procedure for disabling and enabling SRS ● SRS repair safety
<p>6.33 Verify windshield wiper and washer operation; replace wiper blades</p>	<ul style="list-style-type: none"> ● Wiper blade replacement ● Wiper operation ● Intermittent wiper operation
<p>STANDARD 9.0 PERFORM AUTOMOTIVE SHOP AND SAFETY TASKS</p>	
<p>9.1 Exhibit general shop safety rules and procedures</p>	<ul style="list-style-type: none"> ● Safety and pollution prevention <ul style="list-style-type: none"> ○ Examples <ul style="list-style-type: none"> ■ Career Safe/OSHA10 ■ CDX

	<ul style="list-style-type: none"> ■ SP2 Certification ● Shop procedures
9.2 Utilize safe procedures for handling of tools and equipment	<ul style="list-style-type: none"> ● Safe procedures <ul style="list-style-type: none"> ○ Proper tool/equipment usage ○ Maintenance of tools/equipment ● Tool/Equipment identification
9.3 Demonstrate proper placement of floor jacks and jack stands	<ul style="list-style-type: none"> ● Safe procedures <ul style="list-style-type: none"> ○ Identifying proper lift points ○ Researching proper lift points on different vehicles ○ Proper placement of jack stands
9.4 Demonstrate proper procedures for safe lift operation	<ul style="list-style-type: none"> ● Safe procedures <ul style="list-style-type: none"> ○ Identifying proper lift points ○ Researching proper lift points on different vehicles ○ Checking and using safety systems on vehicle lifts
9.5 Utilize proper ventilation procedures for working within the lab/shop area	<ul style="list-style-type: none"> ● Safety procedures <ul style="list-style-type: none"> ○ Identifying when to use ventilation systems
9.6 Identify marked safety areas	<ul style="list-style-type: none"> ● Identify marked safety areas ● Identify safety signage
9.7 Identify the location and the types of fire extinguishers and other fire safety equipment	<ul style="list-style-type: none"> ● Identify the four classes of fire extinguishers ● Location of fire extinguishers and other fire safety equipment (fire blanket, etc.)
9.8 Demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment	<ul style="list-style-type: none"> ● Safe procedures <ul style="list-style-type: none"> ○ Describe how to use fire extinguishers ○ Pull, Aim, Squeeze, Sweep (PASS) ○ Fire blanket use
9.9 Identify the location and use of eye wash stations	<ul style="list-style-type: none"> ● Identifying eye wash station locations ● Proper use of eye wash stations
9.10 Identify the location of the posted evacuation routes	<ul style="list-style-type: none"> ● Identify location of posted evacuation routes
9.11 Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities	<ul style="list-style-type: none"> ● Use proper Personal Protective Equipment (PPE) when in lab/shop <ul style="list-style-type: none"> ○ Examples:

	<ul style="list-style-type: none"> ■ Safety glasses ■ Ear protection ■ Gloves ■ Closed-toe shoes ■ Respiratory
9.12 Wear appropriate clothing for lab/shop activities	<ul style="list-style-type: none"> ● Wear appropriate clothing when in lab/shop <ul style="list-style-type: none"> ○ Examples: <ul style="list-style-type: none"> ■ Shop shirts ■ Pants ■ Closed-toed shoes
9.13 Secure hair and jewelry for lab/shop activities	<ul style="list-style-type: none"> ● Secure hair and jewelry in the lab/shop
9.14 Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems	<ul style="list-style-type: none"> ● Research proper procedure for disabling and enabling SRS system ● Identify proper wiring and connector colors for SRS systems ● Describe proper disposal of SRS components
9.15 Identify vehicle systems which pose a safety hazard during service due to high voltage (i.e., hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.)	<ul style="list-style-type: none"> ● Hybrid/electric drivetrain ● Identify high voltage wiring and systems ● Describe proper safety procedures around high voltage systems ● Research proper procedure for <ul style="list-style-type: none"> ○ High voltage battery isolation ○ Lighting systems ○ Ignition systems ○ A/C systems ○ Injection systems
9.16 Locate and demonstrate knowledge of material safety data sheets (SDS)	<ul style="list-style-type: none"> ● Describe Material Safety Data Sheets (SDS) ● Locate SDS sheets in individual shops <ul style="list-style-type: none"> ○ Hard copy/electronic version
9.17 Identify tools and their usage in automotive applications	<ul style="list-style-type: none"> ● Safe procedures <ul style="list-style-type: none"> ○ Proper tool/equipment usage ○ Maintenance of tools/equipment ● Tool/Equipment identification
9.18 Identify SAE and metric designation	<ul style="list-style-type: none"> ● Identify Standard American English (SAE) and Metric systems ● Proper tool usage with SAE and Metric systems

<p>9.19 Demonstrate safe handling and use of appropriate tools including torque wrenches</p>	<ul style="list-style-type: none"> ● Safe procedures <ul style="list-style-type: none"> ○ Proper tool usage ○ Maintenance of tools ● Tool identification ● Proper storage of torque wrenches
<p>9.20 Demonstrate proper cleaning, storage, and maintenance of tools and equipment</p>	<ul style="list-style-type: none"> ● Properly clean, store, and maintain tools and equipment
<p>9.21 Demonstrate proper use of precision measuring tools (i.e., micrometer, dial-indicator, dial-caliper, etc.)</p>	<ul style="list-style-type: none"> ● Proper use of precision measuring tools <ul style="list-style-type: none"> ○ Micrometer ○ Dial-indicator ○ Dial-caliper
<p>9.22 Identify information necessary and the service requested on a repair order</p>	<ul style="list-style-type: none"> ● Describe the use of a repair order ● Documentation procedures ● Explain customer concern, cause, and correction
<p>9.23 Identify purpose and demonstrate proper use of fender covers, mats, seat, and steering wheel covers</p>	<ul style="list-style-type: none"> ● Purpose and proper use of fender covers, mats, seat, and steering wheel covers
<p>9.24 Perform a vehicle walk-around inspection; identify and document existing vehicle conditions (i.e., body-, paint- and/or windshield damage, etc.)</p>	<ul style="list-style-type: none"> ● Vehicle inspection and documentation <ul style="list-style-type: none"> ○ Body damage ○ Paint damage ○ Windshield damage
<p>9.25 Perform a vehicle multi-point inspection and complete a vehicle inspection report</p>	<ul style="list-style-type: none"> ● Purpose of a multipoint vehicle inspection ● Procedure for documenting an MPI inspection ● Documentation procedures
<p>9.26 Demonstrate use of the three C's (concern, cause, and correction)</p>	<ul style="list-style-type: none"> ● Explain the purpose of the three C's (concern, cause, and correction) ● Demonstrate the use of the three C's on repair orders
<p>9.27 Ensure vehicle is prepared to return to customer per school/company policy (i.e., floor mats, steering wheel cover, etc.)</p>	<ul style="list-style-type: none"> ● Prepare vehicle to return to customer per school/company policy <ul style="list-style-type: none"> ○ Floor mats ○ Steering wheel cover, etc.

Domain 3: Engine Performance Systems and HVAC

Instructional Time: 20 – 25%

STANDARD 1.0 PERFORM ENGINE SERVICES—GENERAL

1.1 Research vehicle service information including fluid type, service precautions and procedures, technical service bulletins, and recalls

- Locate and describe where to find vehicle identification markers, stickers, and placards
 - VIN #
 - Make, Model, Year, Engine Size, Trim Level
 - Mileage
 - Service History
- Conduct online service information research on various vehicles
 - Fluid specs and capacities
 - Maintenance schedule
 - Service precautions
 - Service procedures
 - Technical Service Bulletins (TSB's)
 - Vehicle recalls and/or campaigns

1.2 Identify vehicle systems, including advanced driver assistance systems (ADAS)

- Identify and describe the operation of Advanced Driver Assistance Systems (ADAS)
 - Lane Departure Warning/Correction
 - Automatic Emergency Braking
 - Blind Spot Detection
 - Adaptive Cruise Control
 - Adaptive Lighting Control
 - Automatic Parking
 - Driver Monitoring Systems
 - Full Autonomous Driving Systems

1.3 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed

- Perform a full vehicle module system scan utilizing a scan tool
- Navigating scan tool software, identify and record
 - Diagnostic Trouble Codes (DTCs)
 - On-Board Diagnostic (OBD) Monitor Status
 - Freeze Frame Data
- Demonstrate the proper procedure for clearing DTCs and describe what that does to OBD monitors

<p>1.4 Verify operation of the instrument panel engine warning indicators</p>	<ul style="list-style-type: none"> ● Identify various instrument panel warning indicators and describe what they represent ● Identify what makes instrument panel warning indicators illuminate ● Identify and describe when warning indicator lights should illuminate and when they should turn off during a KOEO test ● Identify next steps if engine warning indicators do not illuminate during the KOEO test
<p>1.5 Inspect engine assembly for fuel, oil, coolant, and other leaks</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting engine assembly for <ul style="list-style-type: none"> ○ Fuel leaks (Fuel Rail, Injectors, Fuel Lines, High-Pressure Fuel Pumps) ○ Oil leaks (Oil Pan, Valve Cover, Front Cover, Crankshaft Seals, Oil Pressure Sensor, Oil Filter) ○ Coolant leaks (Freeze Plugs, Head Gasket, Hoses, Radiator, Overflow Tank) ● Perform a visual inspection of ● Research information <ul style="list-style-type: none"> ○ Describe how to tell different engine leaks apart from each other to identify steps to fix the leak
<p>1.6 Explain the various gaskets, seals, and sealers and their removal and application procedures for engine covers</p>	<ul style="list-style-type: none"> ● Identify various types of gaskets, seals, and sealants used in vehicles <ul style="list-style-type: none"> ○ Cork, rubber, multi-layer steel (MLS), RTV ● Differentiate where gaskets, seals, and sealants are used in an engine ● Describe the procedure for proper removal and installation of new seals, gaskets, and sealants
<p>1.7 Explain procedures for verifying engine mechanical timing</p>	<ul style="list-style-type: none"> ● Identify the locations of camshaft and crankshaft timing marks on various engines ● Utilizing online service information, research the proper procedure for various engines on how to verify that the camshaft and crankshaft timing marks are in the correct location ● Describe possible causes and next steps if marks are not lined up correctly

<p>1.8 Inspect engine and transmission mounts</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting engine and transmission mounts ● Perform a visual inspection of engine and transmission mounts ● Research information <ul style="list-style-type: none"> ○ Describe the repercussions of having broken and/or collapsed engine and transmission mounts
<p>1.9 Identify service precautions related to service of the internal combustion engine of a hybrid electric vehicle</p>	<ul style="list-style-type: none"> ● Research, identify, and list manufacturer specific service precautions from an approved online source technicians need to be aware of while servicing internal combustion engines in hybrid vehicles
<p>1.10 Explain the components and configuration of the cylinder head and valve train</p>	<ul style="list-style-type: none"> ● Identify different cylinder head and valve train configurations <ul style="list-style-type: none"> ○ OHV - Overhead Valve (pushrod engine) ○ DOHC - Dual Overhead Cam ○ Combustion chamber configurations ○ Solid vs. Roller Cam ○ Hydraulic vs. Solid Lifter ● Identify and describe the operation of cylinder head and valve train components <ul style="list-style-type: none"> ○ Cylinder head ○ Camshafts ○ Valves, springs, retainers, followers, pushrods, and lifters ○ Camshaft timing belts, chains, pulleys, tensioners, and variable valve mechanisms
<p>1.11 Explain the components and configurations of engine block assembly</p>	<ul style="list-style-type: none"> ● Identify different engine block assembly configurations <ul style="list-style-type: none"> ○ Horizontally opposed, rotary, slant, straight, V- and W-shaped blocks ● Identify and describe the components and operation of engine block (short block) assembly <ul style="list-style-type: none"> ○ Crankshaft, Main/Thrust bearings, and caps ○ Connecting rods, bearings, cap, and wrist pin ○ Pistons and rings
<p>1.12 Explain the function of lubrication and cooling system components and configurations</p>	<ul style="list-style-type: none"> ● Identify and describe different lubrication and cooling system configurations <ul style="list-style-type: none"> ○ Wet sump vs. dry sump ○ Oil pump types

	<ul style="list-style-type: none"> ○ Downflow and reverse flow cooling systems ○ Drive belt vs. timing chain driven water pumps ● Identify and describe the components and operation of the lubrication and cooling system <ul style="list-style-type: none"> ○ Oil, oil pump, galleries, filters, dipstick, pickup tube, etc. ○ Water pump, coolant, hoses, radiator, heater core, thermostat, pressure tank and cap, etc.
1.13 Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required	<ul style="list-style-type: none"> ● Research manufacturer specifications in regard to proper oil quantity, quality, and viscosity in preparation for oil change ● Research various vehicle reset procedures for maintenance reminders ● Perform an engine oil and filter change on various vehicles following proper manufacturer procedures
1.14 Perform cooling system pressure test to identify leaks; check coolant condition and level; inspect and test pressure cap; determine necessary action	<ul style="list-style-type: none"> ● Describe the function of a cooling system pressure cap ● Identify what a bad pressure cap looks like and the customer complaints/symptoms of a bad pressure cap ● Perform a cooling system pressure test (check for leaks and if the system holds pressure) <ul style="list-style-type: none"> ○ Determine next steps for a failed test ● Describe various coolant types and concentration levels and how they apply to different years, makes, and models of vehicles ● Check proper fluid level; inspect coolant condition using various methods (refractometer, electrical conductivity, hydrometer, etc.)
1.15 Explain causes of engine overheating	<ul style="list-style-type: none"> ● Describe various causes of engine overheating <ul style="list-style-type: none"> ○ Stuck closed thermostat ○ Partially stuck closed thermostat ○ Low coolant ○ Clogged/damaged radiator tubes and fins ○ Inoperative electric fan/fan clutch ○ Cooling system pressure cap issues ● Describe consequences of having an engine overheat
1.16 Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting drive belts, tensioners, and pulleys; check pulley and belt alignment

	<ul style="list-style-type: none"> ● Perform a visual inspection of drive belts, tensioners, and pulleys; check pulley and belt alignment ● Research information <ul style="list-style-type: none"> ○ Identify various types of drive belts (serpentine, v-belt, stretch belt) ○ Identify various accessory drive pulleys (alternator, crankshaft, A/C compressor, power steering pump, idler, tensioner) ○ Identify what a bad drive belt looks like and the customer complaint/symptoms of a bad drive belt ○ Describe the consequences for having pulley and belt alignment issues ● Inspect, replace, and if necessary adjust drive belts on various vehicles ● Verify correct pulley and belt alignment
<p>1.17 Inspect and test coolant; drain and recover coolant; flush and refill cooling system; use proper fluid type per manufacturer specification; bleed air as required</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting coolant ● Perform a visual inspection of coolant condition using refractometer, hydrometer, and voltmeter ● Research information <ul style="list-style-type: none"> ○ Vehicle antifreeze per manufacturer specifications ● Drain, recover, flush, and refill cooling systems on various vehicles following manufacturer procedures
<p>1.18 Explain procedures for removing, inspecting, and replacing thermostat and gasket/seal</p>	<ul style="list-style-type: none"> ● Describe the function of a cooling system thermostat and how it relates to proper engine operation ● Identify what a bad thermostat looks like and the customer complaint/symptoms of a bad thermostat ● List the steps to properly remove, inspect, and replace a cooling system thermostat and gasket/seal
<p>1.19 Explain the procedure to perform common fastener and thread repair to include proper torquing</p>	<ul style="list-style-type: none"> ● Identify various types of fasteners <ul style="list-style-type: none"> ○ Metric vs. Standard fasteners ○ Metric vs. Standard thread pitch ○ Grades and strength of fasteners ● List the steps to properly perform a fastener and thread repair using tap, die, thread chaser, and thread inserts ● Perform fastener and thread repair using tap, die, thread chaser, and thread inserts

	<ul style="list-style-type: none"> Describe the proper way to accurately torque fasteners to specifications
STANDARD 7.0 PERFORM HEATING, VENTILATION AND AIR CONDITIONING (HVAC) SYSTEM SERVICES—GENERAL	
7.1 Research vehicle service information including fluid type, service precautions and procedures, technical service bulletins, and recalls	<ul style="list-style-type: none"> Locate and describe where to find vehicle identification markers, stickers, and placards <ul style="list-style-type: none"> VIN # Make, Model, Year, Engine Size, Trim Level Mileage Service History Conduct online service information research on various vehicles <ul style="list-style-type: none"> Fluid specs and capacities Maintenance schedule Service precautions Service procedures Technical Service Bulletins (TSB's) Vehicle recalls and/or campaigns
7.2 Identify vehicle systems, including advanced driver assistance systems (ADAS)	<ul style="list-style-type: none"> Identify and describe the operation of Advanced Driver Assistance Systems (ADAS) <ul style="list-style-type: none"> Lane Departure Warning/Correction Automatic Emergency Braking Blind Spot Detection Adaptive Cruise Control Adaptive Lighting Control Automatic Parking Driver Monitoring Systems
7.3 Describe heating, ventilation and air conditioning (HVAC) components and configuration	<ul style="list-style-type: none"> Identify various HVAC system configurations used on vehicles <ul style="list-style-type: none"> R12, R134a, and R1234YF Thermostatic Expansion Valve Orifice Identify and describe components of HVAC systems Refrigerant, compressors, lines, evaporator, condenser, dryer/accumulator, pressure switches, AC Case, blower motor, HVAC head controls, door actuators (electronic and vacuum)
7.4 Retrieve and record DTCs, OBD monitor status, and freeze frame	<ul style="list-style-type: none"> Perform a full vehicle module system scan utilizing a scan tool

<p>data; clear codes and data when directed</p>	<ul style="list-style-type: none"> ● Navigating scan tool software, identify and record <ul style="list-style-type: none"> ○ Diagnostic Trouble Codes (DTCs) ○ On-Board Diagnostic (OBD) Monitor Status ○ Freeze Frame Data ● Demonstrate the proper procedure for clearing DTCs and describe what that does to OBD monitors
<p>7.5 Explain the steps of an A/C performance test including connections, pressure gauges, identifying refrigerant, and coagulin</p>	<ul style="list-style-type: none"> ● Proper vent temperatures ● Checking static A/C pressures
<p>7.6 Describe abnormal operating noises in the A/C system</p>	<ul style="list-style-type: none"> ● Improper clutch clearance ● Low pressure hissing
<p>7.7 Visually inspect A/C components for signs of leaks</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting A/C components ● Perform a visual inspection of A/C components for leaks ● Research information
<p>7.8 Interpret heating and air conditioning problems</p>	<ul style="list-style-type: none"> ● Visual inspection <ul style="list-style-type: none"> ○ Parts identification ● Research information
<p>7.9 Inspect and replace A/C compressor drive belts, pulleys, and tensioners; determine necessary action</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting A/C compressor drive belts, pulleys, and tensioners ● Perform a visual inspection of A/C compressor drive belts, pulleys, and tensioners ● Research information
<p>7.10 Inspect A/C condenser for airflow restrictions; determine necessary action</p>	<ul style="list-style-type: none"> ● Explain why proper airflow is needed ● How restrictions effect system ● How improper fan operation effects system ● Part identification ● Research information <ul style="list-style-type: none"> ○ Visual inspection ● Procedure
<p>7.11 Inspect evaporator housing condensation drain; determine necessary action</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting evaporator housing condensation drain <ul style="list-style-type: none"> ○ Locating drain ● Perform a visual inspection of evaporator housing condensation drain

	<ul style="list-style-type: none"> ○ Ensure drain is not plugged and is draining properly ● Research information
7.12 Inspect engine cooling and heater systems hoses and pipes; determine necessary action	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting engine cooling and heater systems hoses and pipes <ul style="list-style-type: none"> ○ Identify hose routing and individual hoses ○ Use of molded hoses ● Perform a visual inspection of engine cooling and heater systems hoses and pipes ● Research information <ul style="list-style-type: none"> ○ Visual inspection ○ Procedure
7.13 Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting HVAC system ducts, doors, hoses, cabin filters, and outlets ● Perform a visual inspection of HVAC system ducts, doors, hoses, cabin filters, and outlets ● Research information <ul style="list-style-type: none"> ○ Cabin filter replacement ○ Identifying blend doors ○ Visual inspection ○ Procedure
7.14 Identify the source of HVAC system odors	<ul style="list-style-type: none"> ● Potential sources of HVAC systems odors ● Research Technical Service Bulletins (TSB)
7.15 Demonstrate the need to recover, recycle, and handle refrigerants using proper equipment and procedures	<ul style="list-style-type: none"> ● Explain environmental hazards ● Explain need for recovery and recycling
STANDARD 8.0 PERFORM ENGINE PERFORMANCE SERVICES – GENERAL	
8.1 Research vehicle service information including fluid type, service precautions and procedures, technical service bulletins, and recalls	<ul style="list-style-type: none"> ● Locate and describe where to find vehicle identification markers, stickers, and placards <ul style="list-style-type: none"> ○ VIN # ○ Make, Model, Year, Engine Size, Trim Level ○ Mileage ○ Service History

	<ul style="list-style-type: none"> ● Conduct online service information research on various vehicles <ul style="list-style-type: none"> ○ Fluid specs and capacities ○ Maintenance schedule ○ Service precautions ○ Service procedures ○ Technical Service Bulletins (TSB's) ○ Vehicle recalls and/or campaigns
8.2 Identify vehicle systems, including advanced driver assistance systems (ADAS)	<ul style="list-style-type: none"> ● Identify and describe the operation of Advanced Driver Assistance Systems (ADAS) <ul style="list-style-type: none"> ○ Lane Departure Warning/Correction ○ Automatic Emergency Braking ○ Blind Spot Detection ○ Adaptive Cruise Control ○ Adaptive Lighting Control ○ Automatic Parking ○ Driver Monitoring Systems
8.3 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed	<ul style="list-style-type: none"> ● Perform a full vehicle module system scan utilizing a scan tool ● Navigating scan tool software, identify and record <ul style="list-style-type: none"> ○ Diagnostic Trouble Codes (DTCs) ○ On-Board Diagnostic (OBD) Monitor Status ○ Freeze Frame Data ● Demonstrate the proper procedure for clearing DTCs and describe what that does to OBD monitors
8.4 Demonstrate understanding of proper engine cooling system operation	<ul style="list-style-type: none"> ● Describe proper engine cooling system operation
8.5 Describe camshaft timing including engines equipped with variable valve timing (VVT) and/or variable lift systems	<ul style="list-style-type: none"> ● Explain system and its uses ● Explain valve timing and valve lift systems
8.6 Explain computerized control system components and configurations	<ul style="list-style-type: none"> ● Identify and describe computerized control system components and configurations <ul style="list-style-type: none"> ○ OBD1, OBD2, CAN
8.7 Explain ignition system components and configurations	<ul style="list-style-type: none"> ● Explain coil on plug systems ● Explain safety around high voltage ignition systems ● Identify spark plug wires and servicing procedure

<p>8.8 Describe the removal and replacement of spark plugs and the inspection of secondary ignition components for wear and damage</p>	<ul style="list-style-type: none"> ● Safety ● Part identification ● Research information <ul style="list-style-type: none"> ○ Spark gap ○ Visual inspection of spark plug ○ Torque value ○ Anti-seize ● Procedure
<p>8.9 Describe fuel, air induction, and exhaust system components and configurations</p>	<ul style="list-style-type: none"> ● Identify different fuel injection systems ● Explain the use and purpose of forced induction ● Identify exhaust system components
<p>8.10 Explain fuel filter(s) replacement(s) where applicable</p>	<ul style="list-style-type: none"> ● Safety precautions ● Research proper service procedure
<p>8.11 Inspect, service, or replace air filters, filter housings, and intake duct work</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting air filters, filter housings, and intake duct work ● Perform a visual inspection of air filters, filter housings, and intake duct work ● Research information ● Replace engine air filter
<p>8.12 Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields; determine necessary action</p>	<ul style="list-style-type: none"> ● Explain the purpose of catalytic converters ● Identify where to look and what to look for when visually inspecting exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields ● Perform a visual inspection of exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields ● Research information
<p>8.13 Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine necessary action</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting exhaust system hangers, brackets, clamps, and heat shields ● Perform a visual inspection of exhaust system hangers, brackets, clamps, and heat shields ● Research information

8.14 Explain procedures to check and refill diesel exhaust fluid (DEF)	<ul style="list-style-type: none"> ● Safety precautions ● Research proper service procedure ● Identify proper filling location
8.15 Describe emission control system components and configurations	<ul style="list-style-type: none"> ● Identify emission control system components and configurations on vehicle ● Explain the purpose of emission systems
8.16 Inspect, test, and service positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; perform necessary action	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses <ul style="list-style-type: none"> ○ Identify components of PCV system ● Perform a visual inspection of positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses ● Research information <ul style="list-style-type: none"> ○ Explain the purpose of PCV system ○ Servicing of PCV system

Domain 4: Transmissions and Drive Trains

Instructional Time: 10 – 15%

STANDARD 2.0 PERFORM AUTOMATIC TRANSMISSION AND TRANSAXLE SERVICES—GENERAL

2.1 Research vehicle service information including fluid type, service precautions and procedures, technical service bulletins, and recalls	<ul style="list-style-type: none"> ● Locate and describe where to find vehicle identification markers, stickers, and placards <ul style="list-style-type: none"> ○ VIN # ○ Make, Model, Year, Engine Size, Trim Level ○ Mileage ○ Service History ● Conduct online service information research on various vehicles <ul style="list-style-type: none"> ○ Fluid specs and capacities ○ Maintenance schedule ○ Service precautions ○ Service procedures ○ Technical Service Bulletins (TSB's) ○ Vehicle recalls and/or campaigns
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<p>2.2 Identify vehicle systems, including advanced driver assistance systems (ADAS)</p>	<ul style="list-style-type: none"> ● Identify and describe the operation of Advanced Driver Assistance Systems (ADAS) <ul style="list-style-type: none"> ○ Lane Departure Warning/Correction ○ Automatic Emergency Braking ○ Blind Spot Detection ○ Adaptive Cruise Control ○ Adaptive Lighting Control ○ Automatic Parking ○ Driver Monitoring Systems
<p>2.3 Explain automatic transmission and transaxle components and configurations</p>	<ul style="list-style-type: none"> ● Identify and describe different transmission and transaxle configurations ● Identify and describe the components and operation of transmission and transaxles <ul style="list-style-type: none"> ○ Planetary gear operation (Sun, Planets, Ring, etc.) ○ Clutches and discs ○ Valve body, solenoids, sensors, etc. ○ Pump, lines, coolers, fluid, etc. ○ Torque converter, lockup clutch
<p>2.4 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed</p>	<ul style="list-style-type: none"> ● Perform a full vehicle module system scan utilizing a scan tool ● Navigating scan tool software, identify and record <ul style="list-style-type: none"> ○ Diagnostic Trouble Codes (DTCs) ○ On-Board Diagnostic (OBD) Monitor Status ○ Freeze Frame Data ● Demonstrate the proper procedure for clearing DTCs and describe what that does to OBD monitors
<p>2.5 Inspect transmission fluid condition and level, and check for leaks in a transmission or a transaxle equipped with a dipstick</p>	<ul style="list-style-type: none"> ● Inspect a transmission for fluid leaks <ul style="list-style-type: none"> ○ Axle Seals, Oil Pan, Cooler Lines, Case, Sensor/Switches ● Describe and perform proper procedure for checking ATF fluid level and condition in various vehicles ● Research information <ul style="list-style-type: none"> ○ Proper manufacturer procedures in checking fluid level in various vehicles
<p>2.6 Inspect transmission fluid condition and level, and check for leaks in a transmission or a transaxle not equipped with a dipstick</p>	<ul style="list-style-type: none"> ● Inspect a transmission for fluid leaks <ul style="list-style-type: none"> ○ Axle Seals, Oil Pan, Cooler Lines, Case, Sensor/Switches

	<ul style="list-style-type: none"> • Describe and perform proper procedure for checking ATF fluid level and condition in various vehicles • Research proper manufacturer procedures in checking fluid level in various vehicles
2.7 Explain transmission/transaxle gear reduction/multiplication operation using driving, driven, and held member (power flow) principles	<ul style="list-style-type: none"> • Define gear reduction/multiplication, drive gear, driven gear, and held member • Identify and describe Sun Gear, Planet Gear and Carrier, Ring Gear (Planetary Gear Setup) • Explain how planetary gears operate to get gear reduction, gear multiplication, 1:1 and reverse (Example: If the sun gear is the drive gear, the planet gears/carrier are the driven gear, and the ring gear is held, what is the outcome? Gear Reduction/Torque Increase)
2.8 Explain hydraulic principles (Pascal's Law) in a transmission/transaxle	<ul style="list-style-type: none"> • Define Pascal's law, and calculate simple hydraulic calculations (force developed and force applied to pistons of different sizes) • Describe how hydraulics are utilized in automatic transmissions to apply pistons to achieve different outcomes for planetary gear sets
2.9 Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch	<ul style="list-style-type: none"> • Identify various transmission/transaxle shift linkage, sensors, switches, and park/neutral position switches • Inspect shift linkage for looseness, binding, damage, and proper operation; adjust if needed • Inspect speed sensors, switches, and park/neutral position switches; adjust if needed • Replace speed sensors; check O-ring • Replace and adjust park/neutral position switch
2.10 Explain procedures to drain and replace fluid and filter(s) to include proper fluid type per manufacturer specification	<ul style="list-style-type: none"> • Research fluid type and quantity on various automatic transmission/transaxles to prepare for fluid replacement • Research and describe fluid drain, filter replacement, and refill procedures on various automatic transmission/transaxles
2.11 Explain relearn procedure	<ul style="list-style-type: none"> • Research and explain relearn procedures on automatic transmission/transaxles
2.12 Inspect, replace and/or align powertrain mounts	<ul style="list-style-type: none"> • Identify where to look and what to look for when visually inspecting transmission mounts

	<ul style="list-style-type: none"> ● Research information <ul style="list-style-type: none"> ○ Describe the repercussions of having broken, misaligned, and/or collapsed transmission mounts ● Replace powertrain mounts on various vehicles
2.13 Describe the operational characteristics of a continuously variable transmission (CVT)	<ul style="list-style-type: none"> ● Research and describe operational characteristics of a CVT transmission on various vehicles
2.14 Describe the operational characteristics of a hybrid vehicle drivetrain	<ul style="list-style-type: none"> ● Research and describe operational characteristics of a hybrid vehicle drive train system on various hybrid vehicles
STANDARD 3.0 PERFORM MANUAL DRIVETRAIN AND AXLE SERVICES—DRIVE SHAFT, HALF SHAFTS, UNIVERSAL JOINTS AND CONSTANT VELOCITY (CV) JOINTS (FRONT, REAR, ALL WHEEL AND 4-WHEEL DRIVE)	
3.1 Research vehicle service information including fluid type, service precautions and procedures, technical service bulletins, and recalls	<ul style="list-style-type: none"> ● Locate and describe where to find vehicle identification markers, stickers, and placards <ul style="list-style-type: none"> ○ VIN # ○ Make, Model, Year, Engine Size, Trim Level ○ Mileage ○ Service History ● Conduct online service information research on various vehicles <ul style="list-style-type: none"> ○ Fluid specs and capacities ○ Maintenance schedule ○ Service precautions ○ Service procedures ○ Technical Service Bulletins (TSB's) ○ Vehicle recalls and/or campaigns
3.2 Identify vehicle systems, including advanced driver assistance systems (ADAS)	<ul style="list-style-type: none"> ● Identify and describe the operation of Advanced Driver Assistance Systems (ADAS) <ul style="list-style-type: none"> ○ Lane Departure Warning/Correction ○ Automatic Emergency Braking ○ Blind Spot Detection ○ Adaptive Cruise Control ○ Adaptive Lighting Control ○ Automatic Parking ○ Driver Monitoring Systems

<p>3.3 Describe manual drive train components and configuration</p>	<ul style="list-style-type: none"> ● Identify and describe different manual drivetrain configurations <ul style="list-style-type: none"> ○ 2wd, 4wd, AWD ● Identify and describe the components and operation of manual drive trains <ul style="list-style-type: none"> ○ Driveshaft, CV shafts, U-joints ○ Transfer case, Power Transfer Units (PTU) ○ Differentials (Pinion Gear and Seal, bearings, Ring Gear, axles and bearings, and differential locking mechanisms) ○ Manual Transmissions and components (gears, input/output shafts, synchronizers, shift forks, shift linkage, etc.)
<p>3.4 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed</p>	<ul style="list-style-type: none"> ● Perform a full vehicle module system scan utilizing a scan tool ● Navigating scan tool software, identify and record <ul style="list-style-type: none"> ○ Diagnostic Trouble Codes (DTCs) ○ On-Board Diagnostic (OBD) Monitor Status ○ Freeze Frame Data ● Demonstrate the proper procedure for clearing DTCs and describe what that does to OBD monitors
<p>3.5 Check fluid condition; check for leaks</p>	<ul style="list-style-type: none"> ● Check fluid condition and check for leaks <ul style="list-style-type: none"> ○ Manual transmission/transaxle ○ Transfer case/PTU ○ Differentials
<p>3.6 Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification</p>	<ul style="list-style-type: none"> ● Following manufacturer service procedures, drain and refill manual transmission/transaxles on various vehicles ● Research proper fluid type and quantity on various vehicles per manufacturer specifications
<p>3.7 Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification</p>	<ul style="list-style-type: none"> ● Check clutch master cylinder fluid level and condition; adjust if needed ● Identify and check for potential leak points on a clutch master cylinder ● Research proper fluid type and quantity on various vehicle clutch master cylinders per manufacturer specifications
<p>3.8 Describe the operational characteristics of an electronically controlled manual transmission/transaxle</p>	<ul style="list-style-type: none"> ● Research and describe the operational characteristics of an electronically controlled manual transmission/transaxle

<p>3.9 Inspect, remove, and/or replace bearings, hubs, and seals</p>	<ul style="list-style-type: none"> ● Identify various bearings, hubs, and seals used <ul style="list-style-type: none"> ○ Tapered bearings, retainers, caps, and wheel seals ○ Sealed wheel bearing hubs (bolt on and pressed) ○ Rear axle bearings and seals ● Inspect, remove, and replace various types of wheel bearings, hubs, and seals for FWD, RWD, 4WD, and AWD vehicles
<p>3.10 Inspect, service, and/or replace shafts, yokes, boots, and universal/CV joints</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting shafts, yokes, boots, and universal/CV joints ● Perform a visual inspection of shafts, yokes, boots, and universal/CV joints ● Research information
<p>3.11 Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification</p>	<ul style="list-style-type: none"> ● Identify and check potential leak points on differentials, PTUs, and transfer cases ● Research fluid type and quantity on various differentials, PTUs, and transfer cases per manufacturer specifications ● Check fluid level on various vehicles differential, PTUs, and transfer cases
<p>3.12 Inspect differential housing; check for leaks; inspect housing vent</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting differential housing <ul style="list-style-type: none"> ○ Identify various leak points to inspect on differential housings ● Perform a visual inspection of differential housing <ul style="list-style-type: none"> ○ Inspect differential housing for leaks at these points ○ Inspect differential housing vent ● Research information
<p>3.13 Explain procedures to adjust differential housing fluid level; use proper fluid type per manufacturer specification</p>	<ul style="list-style-type: none"> ● Research and explain the procedure on how to adjust various differential housing fluid levels for different vehicles ● Research differential housing fluid type and quantity used in various vehicles
<p>3.14 Inspect and replace drive axle wheel studs</p>	<ul style="list-style-type: none"> ● Identify where to look and what to look for when visually inspecting drive axle wheel studs ● Perform a visual inspection of drive axle wheel studs ● Research information <ul style="list-style-type: none"> ○ Inspect and identify what good and bad axle wheel studs look like

	<ul style="list-style-type: none">○ Replace axle wheel studs on various vehicles
3.15 Identify concerns related to variations in tire circumference and/or final drive ratios	<ul style="list-style-type: none">● Identify and describe how tire circumference plays a role in AWD vehicles● Identify concerns related to differences in tire circumference in AWD and/or final drive ratios and how they can affect the vehicle's performance and longevity

